

REPORT DOCUMENTATION PAGE

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4. TITLE AND SUBTITLE A NEW DIELECTRIC RESONATOR ANTENNA ARRAY (DRAA) OPERATING WITH MAGNETO-DIELECTRIC MATERIALS FOR USE IN HIGH TEMPERATURE ENVIRONMENTS				5a. CONTRACT NUMBER	
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14. ABSTRACT The main objective of this work was to study , the dielectric properties of the Gd ₁ GXYIGI-X ferrite composite material at radio frequency (RF) and microwave frequency bands were studied. These measurements were carried out in different sample geometries: thick films and cylindrical ceramic bulk ferrite resonator. In the RF range, we observed that the material is rather stable because of its short changes as a function of temperature and frequency range. The temperature capacitance coefficient samples) presented short positive values at the RF range. In the study of the dielectric properties of the composites antenna geometry, with the same ferrite composite, a bulk cylindrical geometry was also investigated.					
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FINAL TECHNICAL REPORT- FA9550-08-1-0210

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Subject: Final Progress Statement to Dr. Harold Weinstock AFRL/AFOSR"

Investigator name : Dr. Antonio Sergio Bezerra Sombra

Contract/Grant Title: A NEW DIELECTRIC RESONATOR ANTENNA OPERATING
WITH MAGNETO-DIELECTRIC MATERIALS BASED IN $Y_3Fe_{5-2x}Bi_xB_x$ GARNETS.

Contract/Grant : FA9550-08-1-0210

Reporting Period: 05 MAR 2009 to 28 FEB 2010

Annual accomplishments (200 words max):

In this study, the dielectric properties of the $GdIG_xYIG_{1-x}$ ferrite composite material at radio frequency (RF) and microwave frequency bands were studied. These measurements were carried out in different sample geometries: thick films and cylindrical ceramic bulk ferrite resonator antennas. In the RF range, we observed that the material is rather stable because of its small changes as a function of temperature and the frequency range. The temperature capacitance coefficient TCC were measured for all the samples (thick films and cylindrical ceramic bulk samples) and presented short positive values at the RF range.

The $GdIG_{0.5}YIG_{0.5}$ thick film was used as a substrate for the microstrip antenna device, where the upper Ag electrode served as a circular patch antenna and a microstrip line was used as a feed line. The microstrip antenna operates in this configuration at 8.185 GHz. These measurements were carried out in two different kinds of samples: thick films and cylindrical ceramic bulk ferrite resonator. A numerical study, together with the experimental data, was done, and the dielectric characteristics of the composite like (dielectric permittivity) ϵ_r , (dielectric loss) $tg\delta_E$, (permeability) μ_r and (magnetic loss) $tg\delta_H$ were obtained. The simulations of the microstrip antenna and the ferrite resonator antenna

(FRA) were performed using the Ansoft's high-frequency structure simulator (HFSS), a software package based on the finite element method. The numerical validation of the experimental setup was an objective of this study. First, the influence of the probe on the resonant frequencies was investigated. Besides, the high sensitivity of the results as a function of the air gap can be confirmed. Finally, HFSS software provides the radiation patterns of the antennas under investigation.

Archival publications (published) during reporting period:

Supervision of PhD Thesis

1- Synthesis and Study of the Dielectric Properties of the Ceramic Composites $[(\text{Cr}_{3/8}\text{Fe}_{5/8})_2\text{O}_3\text{-CRFO}]_{[x]}\text{-}[\text{CaTiO}_3\text{-CTO}]_{[1-x]}$ e $[\text{BiFeO}_3\text{-BFO}]_{[x]}\text{-}[\text{CaTiO}_3\text{-CTO}]_{[1-x]}$

Manoel Roberval Pimentel Santos

Physics Department-Federal University of Ceará - UFC

FEB (2009)

2- Study of dielectric and magnetic properties of M type hexaferrite ($\text{Ba}_x\text{Sr}_{1-x}\text{Fe}_{12}\text{O}_{19}$) for use in electronic devices

Francisca Maria Martins Pereira

Chemistry Department-Federal University of Ceará- UFC JUN(2009)

Supervision of MSc Thesis

1-Stduy of the Electrical and structural Characteristics of $\text{SrBi}_2\text{Nb}_2\text{O}_9$ (SBN) doped with La_2O_3 , PbO e Bi_2O_3 .

Marta Jussara Souza da Rocha

Physics Department-Federal University of Ceará- UFC (JAN 2009)

2-Study of the dielectric properties of Niobium and Bismuth Titanate ($\text{Bi}_3\text{TiNbO}_9\text{-BTNO}$) Doped with PbO e Bi_2O_3 for antenna applications

Roger Ribeiro Silva, Physics Department-Federal University of Ceará- UFC ,(FEB 2009)

3-Study of the Structural and electrical properties of $\text{Bi}_4\text{Ti}_3\text{O}_{12}$ (BIT) doped with ZnO or La_2O_3 for RF applications

Helainne Thomeny Girão, Tellecomunications Department-UFC (JAN 2010)

International Publications

1- Synthesis, Structure and Vibrational Properties of $\text{GdIG}_x\text{:YIG}_{1-x}$ Ferrimagnetic Ceramic Matrix Composite

P. B. A. Fechine, E. N. Silva, A. S. de Menezes, J. Derov, J. W. Stewart, A. J. Drehman, I. F. Vasconcelos, A. P. Ayala, L. P. Cardoso and A. S. B. Sombra

Journal of Physics and Chemistry of Solids 70 (1)(2009)202-209
(Elsevier)

2- Studies of the Temperature Coefficient of Capacitance (TCC) of a New Electroceramic Composite: $\text{Pb}(\text{Fe}_{0.5}\text{Nb}_{0.5})\text{O}_3$ (PFN)- $\text{Cr}_{0.75}\text{Fe}_{1.25}\text{O}_3$ (CRFO)

F.N.A. Freire, M.R.P. Santos, F. M.M. Pereira, R.S.T.M. Sohn, J. S. Almeida ,
A. M. L. Medeiros , E. O. Sancho , M.M. Costa and A.S.B. Sombra.

Journal of Materials Science: Materials in Electronics, 20(2)(2009)149-156
(Springer)

3- Structural and Electrical Study of $\text{CaCu}_3\text{Ti}_4\text{O}_{12}$ (CCTO) Obtained in a New Ceramic Procedure

A.F. L. Almeida, P. B. A. Fechine, M. P. F. Graça, M. A. Valente and A. S. B. Sombra

Journal of Materials Science: Materials in Electronics, 20(2)(2009)163-170
(Springer)

4-MAGNETIC AND DIELECTRIC PROPERTIES OF THE M-TYPE BARIUM STRONTIUM HEXAFERRITE ($\text{Ba}_x\text{Sr}_{1-x}\text{Fe}_{12}\text{O}_{19}$) IN THE RF AND MICROWAVE (MW) FREQUENCY RANGE

F. M. M. Pereira, M. R. P. Santos, R. S. T. M. Sohn, J. S. Almeida, A. M. L. Medeiros,
M.M. Costa and A. S. B. Sombra

Journal of Materials Science: Materials in Electronics, 20(5) (2009) 408-417
(Springer)

5- Structural properties of $\text{CaTi}_{1-x}(\text{Nb}_{2/3}\text{Li}_{1/3})_x\text{O}_3$ (CNLTO) and $\text{CaTi}_{1-x}(\text{Nb}_{1/2}\text{Ln}_{1/2})_x\text{O}_3$ ($\text{Ln}=\text{Fe}$ (CNFTO), Bi (CNBTO)), modified dielectric ceramics for microwave applications

R.C.S. Costa, A.D.S. Bruno Costa, F.N.A. Freire, M.R.P. Santos, J.S. Almeida, R.S.T.M. Sohn, J.M. Sasaki, A.S.B. Sombra

Physica B: Condensed Matter 404(8-11), (2009) 1409-1414 (Elsevier)

6- Bulk and Patch Ferrite Resonator Antennas Based in the Ceramic Matrix Composite: $\text{GdIG}_x\text{YIG}_{1-x}$

P. B. A. Fechine, A. F. L. Almeida, R. S. de Oliveira, R.S.T. Moretzsohn, R. R. Silva and
A. S. B. Sombra

Microwave and Optical Technology Letters, 51(6),(2009)1595 – 1602(Wiley)

7-Structural and Electrical Study of Calcium Phosphate Obtained by a Microwave Radiation Assisted Procedure

C.C. Silva , M. P. F. Graça, A.S.B. Sombra and M. A. Valente

Physica B: Condensed Matter, 404(8-11) (2009) 1503-1508 (Elsevier)

8 - Microstructure and magneto-dielectric properties of ferrimagnetic composite

GdIG_x:YIG_{1-x} at radio and microwave frequencies

P. B. A. Fechine, F. M. M. Pereira , M. R. P. Santos F. P. Filho, A. S. de Menezes, R. S. de Oliveira, J. C. Góes, L. P. Cardoso and A. S. B. Sombra

Journal of Physics and Chemistry of Solids, 70(5)(2009) 804-810 (Elsevier)

9-STRUCTURAL PROPERTIES STUDY OF THE MAGNETO-DIELECTRIC

COMPOSITE Cr_{0.75}Fe_{1.25}O₃ (CRFO)-Fe_{0.5}Cu_{0.75}Ti_{0.75}O₃ (FCTO)

H.H.B. Rocha, F.N.A. Freire, R.R. Silva, J.A.C. de Paiva, J.M. Sasaki, M.R.P. Santos J.C. Góes and A.S.B. Sombra.

Journal of Alloys and Compounds 481(1-2)(2009)438-445 (Elsevier)

10- Magnetic properties study on Fe-doped calcium phosphate

C.C.Silva, I.F. Vasconcelos, A.S.B. Sombra and M.A. Valente

Physics Scripta 80 (2009) 055706-055710 (IOP)

11- Study of a microwave ferrite resonator antenna, based in a ferrimagnetic composite

(Gd₃Fe₅O₁₂)GdIGX-(Y₃Fe₅O₁₂)YIG1-X

P. B. A. Fechine, H. H. B. Rocha, R. S. T. Moretzsohn, J. C. Denardin, R. Lavín and A. S. B. Sombra.

IET Microwaves, Antennas & Propagation, 3(8) (2009) 1191-1198 (IET)

12- STRUTURAL STUDIES OF CALCIUM PHOSPHATE DOPED WITH TITANIUM

AND ZIRCONIUM OBTAINED BY HYGH ENERGY MECHANICAL ALLOYING

C. C. Silva and A. S. B. Sombra

Physica Scripta 80 (6) (2009) 065801 -065806 (IOP)

Changes in research objectives, if any: xxxxx

Change in AFOSR program manager, if any: xxxxx

Extensions granted or milestones slipped, if any: xxxxx